



STARWORD

May 2016

Volume 165, Issue 3

LAS BOARD OF DIRECTORS ELECTION

Mark Rockstroh, Editor

UPCOMING EVENTS:

- MAY**
- Fri. 6th: 7:00 pm Mile of Scopes along Bardstown Road
 - Fri. 6th: Last Day to Submit Your Nominations for the Board of Directors
 - Sat. 7th: Member Only Night at Curby
 - Fri. 13th: 8:00 pm Skies Over Louisville at the Planetarium
 - Sat. 14th: 8:00 pm Public Night at Curby
 - Fri. 20th: 6:30 pm Board meeting at UAC
 - Fri. 20th: 8:00 pm General Meeting and Annual Election of the Board of Directors
 - Sat. 21st: 8:00 pm Public Night at the UAC

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Hello LAS Members. It is that time again. On May 20th, we, the membership of the Louisville Astronomical Society will be asked to vote on the Board of Directors from June 2016 to May 2017. In order for your vote to count, you must be listed on our roll. If you are in doubt as to your status, please contact Jeff McCaffrey, LAS Treasurer. Please note that under the By-Laws those with Family Memberships are limited to two votes.

The Board consists of the Officers and 3 Members-At-Large for a total of 12 positions. They are: President, Vice President Secretary, Treasurer, Editor, Historian, Librarian Lunar and Planetary Chairman, Sidewalk Astronomy Chairman, and three Member-At-Large positions.

If you are interested in an Officers or any Board position, please plan on attending the General Meeting on May 20th and self-nominate yourself at the start of the Meeting.

The election will be held at the General Meeting on May 20, 2016 at the Urban Astronomy

Center (UAC) located in E.P. Tom Sawyer State Park. The meeting starts at 8:00 p.m. After the vote, Bo Lowrey will be giving a presentation on Radio Astronomy.

Please note: With our new website going live, we lost access to the Board E-mail addresses. Things sent now to President@Louisville-Astro.org, Vice-President@... Etc. no longer work and will bounce.

With luck, this will be my last update to my last Starword. I was informed by outgoing President John Turack the ballot is now final. If you wish to nominate yourself, please attend be at the Meeting on the 20th. There is always the 2017/2018 year.

Becky Steele is running for the **Editor position**, so let's give her our support. I know Becky will appreciate any articles Members are willing to submit as much as I was and am. It has been a great time serving the LAS Members these last 6 **years as Editor**. Don't worry, I will be around helping out at events.

Continued on Page 2

Board Positions cont'd.

I thank you for your support of the LAS and **Starword over the past 6 years that I've been Editor, and especially this last year as I've served as the Chairman of the Board.**

The Ballot is on Page 4. Pages 2 and 3 are the duties per the By-Law for the Board and Officers.

The Constitution of the LAS States:

V. BOARD OF DIRECTORS

- A Board of Directors shall be the chief governing body of the LAS and shall have general charge of the property, activities, business transactions and policies of the LAS. The Board shall not delegate, to any person, discretionary authority regarding the expenditure or commitment of LAS funds or property.

The [By-Laws](#) contain a description and the duties of the various positions. Member-At-Large duties are assigned by the President and the Board.

Section 1. LAS Officers. LAS officers shall include a President, a Vice President, a Secretary, a Treasurer, an Editor, a Librarian, an Historian, a Sidewalk Astronomy and Public Outreach Chairman and a Lunar and Planetary Chairman. Officers shall be elected at the May general meeting and shall serve for one year or until an election can be held. The performance and conduct of any Board Member is subject to review by the Board of Directors.

Section 2. President. The President shall be the chief executive officer of the LAS, shall decide the agenda for and preside at all gen-

eral membership meetings (in general accordance with Robert's Rules of Order), shall be the official representative of the LAS, shall have general supervision of the affairs of the LAS, shall be an ex officio member of all committees and shall have any other powers as are granted by the Board of Directors or that are proper to the function of the office.

Section 3. Vice-President. The Vice-President shall decide the agenda for and preside at all general or other membership meetings in the absence of the President and shall be in charge of arranging programs for the monthly general membership meetings, and shall have any other powers as are granted by the Board of Directors. The Vice-President shall also be responsible for arranging special activities and programs and for recruiting the manpower to carry out these plans. In the event of death or long-term incapacity of the President, the Vice-President shall serve as Acting President until a new President is selected pursuant to Article IV, Section 1, of these By-Laws.

Section 4. Secretary. The Secretary shall maintain copies of the monthly newsletters, shall keep written and electronic minutes of all meetings, shall maintain the official copy of the LAS Constitution and By-Laws and maintain with such copy an electronic record of all membership and Board meetings, shall have supervision of the current record of the LAS, shall be the official correspondent of the LAS and shall assist the Treasurer in keeping the membership rolls current. The current record shall consist of the minutes of general and Board meetings, monthly newsletters, correspondence, membership lists and special activities information. At the end of the term, all records,

BOARD ELECTION CONT'D

except the official copy of the LAS Constitution and By-Laws and accompanying electronic record, shall be turned over to the new Historian. The Secretary shall perform any other duties as may be properly required by the President or the Board of Directors.

Section 5. Treasurer. The Treasurer shall be the chief financial officer of the LAS, shall be responsible for all monetary assets of the LAS and shall keep a full and accurate record of all financial transactions of the LAS. The Treasurer shall give a monthly report on the current financial status of the LAS and of special fund raising activities. The Treasurer shall keep the membership list current with the help of the Secretary and shall handle all financial correspondence. The Treasurer shall file the LAS Annual Verification Report with the Kentucky Secretary of State no later than June 30 of each year. The Treasurer shall perform any other duties as may be properly required by the President or the Board of Directors.

Section 6. Editor. The Editor shall be responsible for editing, publishing and distribution of a bi-monthly newsletter which will inform the members regarding LAS and Board activities. The Editor shall perform any other duties as may be properly required by the President or Board of Directors.

Section 7. Librarian. The Librarian shall be responsible for maintaining, cataloging and preserving all books, magazines, tapes, slides, films, computer software and other documents in the possession of the LAS, shall oversee the loan or rental of said materials and shall periodically publish a list of said materials for membership use. The Librarian shall perform any other duties as

may be properly required by the President or the Board of Directors.

Section 8. Historian. The Historian shall be responsible for preserving and maintaining an inventory of all past records, minutes, newsletters, photographs, articles and other documents relating to LAS history. The Historian shall perform any other duties as may be properly required by the President or the Board of Directors.

Section 9. Sidewalk Astronomy and Public Outreach Chair. The Sidewalk Astronomy Chair shall be responsible for organizing and planning observing opportunities for the public. These events may include, but are not necessarily limited to, observations for specific groups or organizations to events open to the general public. The Sidewalk Astronomy Chair shall perform any other duties as may be properly required by the President or the Board of Directors.

Section 10. Lunar and Planetary Chairman. The Lunar and Planetary Chairman shall be responsible for presenting to the membership what is up in the sky each month for observing purposes. Lunar and Planetary Chairman shall perform any other duties as may be properly required by the President or the Board of Directors

Section 11. General Obligations. Officers and at-large directors shall be responsible for attending Board Meetings and for safeguarding the interests of the LAS. At-large directors shall perform any other duties as may be properly required by the President or the Board of Directors.

LOUISVILLE ASTRONOMICAL SOCIETY 2016-2017 ELECTION BALLOT
for the Officers and Board of Directors

If you are unable to attend the General Election meeting at 8:00 PM on May 20, 2016 at the Urban Astronomy Center in E.P. "Tom" Sawyer State Park, please mail your completed ballot to be received by **May 18th**, 2016 to LAS, P.O. Box 17554, Louisville, KY 40217-0554.

Remember, under the By-Laws, a Family Membership is limited to two votes only. You must be on the rolls for your vote to count. If you have not yet renewed or are unsure if you have, please contact LAS Treasurer Jeff McCaffrey at 502-376-1635 for verification. If you have not yet renewed or wish to join, you may pay at the door prior to the election. You may also renew or join by going to <https://louisvilleastro.wildapricot.org/join-us>.

Thank you for your cooperation.

President:

Ken Alderson
 Write-In: _____

Vice-President:

Chris Allred
 Write-In: _____

Secretary: Steve Armbrust

Write-In: _____

Treasurer:

Jeff McCaffrey
 Write-In: _____

Sidewalk Astronomy and Public Outreach

Chairman:

Frank Nelson
 Write-In: _____

Lunar and Planetary Chairman:

Ted Erne
 Write-In: _____

Starword Editor:

Becky Steele
 Write-In: _____

Historian:

Stephen Swinney
 Write-In: _____

Librarian:

Ron Yates
 Write-In: _____

Member-At-Large Position: May Select Three (3) Only.

Tom Empson
 Don Spain
 Warren Philpot
 Write-In: _____

Signed _____

Date _____

SCHEDULING INFORMATION

UAC: Urban Astronomy Center located at E.P. "Tom" Sawyer State Park.

Curby: James G Baker Center for Astronomy at Curby, IN.

Planetarium: University of Louisville Gheens Science Hall and Rauch Planetarium

Bernheim: Bernheim Arboretum and Research Forest

BlackAcre: Blackacre Nature Preserve & Historic Homestead

Parklands: The Parklands of Floyds Fork.

PNC Center for Education & Interpretation Beckley Creek Park

Please note the following:

LAS Public Nights at the UAC and Curby are free. The Star Parties (Public Nights at UAC and Curby) start at 8:00 p.m. unless otherwise stated. Programs at Bernheim, the Planetarium, BlackAcre and the Parklands are subject to their stated rates. Please check our website for links to the location to verify their cost and requirements for reservations. Donations to the LAS are welcome and may be tax deductible as the LAS is a 501(c)(3) charitable organization.

Setup is weather permitting. Starting at 8:00 p.m. the LAS will do a program on the night sky using Stellarium and Virtual Lunar Atlas. Both programs are freely available for download.

The Planetarium Skies Over Louisville program begins at 8:00 p.m. LAS Members should plan to arrive and be set-up by 8:15 p.m. as viewing starts after the program lets out. Set-up is in the courtyard and weather dependent.

The Bernheim events will have a charge.

LAS Members volunteering to help with the program may attend free depending on Bernheim requirements. Depending on the program the LAS shares in the proceeds.

Cancellations and updates will be posted to the LAS website as soon as they are known. Please check there often for additions, deletions and cancellations due to weather.

<http://www.louisville-astro.org>

When possible they will be posted on our Yahoo Group page and our Facebook page.

Those wishing to book an event with the Louisville Astronomical Society should contact our Sidewalk Astronomy Chairman.

Scout Leaders should contact Ken Alderson Scout Coordinator at megacoach@aol.com.

If you have suggestions or know someone who would like to come speak at one of our General Meetings, please contact the Vice President.

The LAS Board Meetings are open to Members in good standing. Meetings will normally start at 6:30 p.m. prior to the General Meetings. General Meetings are open to all, including the public. The February, March, April, May, June, September, October General Meetings will start at 8:00 p.m. The February 2016 General Meeting is scheduled to take place at Strickler Hall. The others are scheduled to take place at the UAC.

MAY

Fri. 6th: 7:00 pm Mile of Scopes along Bardstown Road

Fri. 6th: Last Day to Submit Your Nominations for the Board of Directors

Sat. 7th: Member Only Night at Curby

2016 SCHEDULE

MAY

- Fri. 13th: 8:00 pm Skies Over Louisville at the Planetarium
 Fri. 13th: Planet Derby at the Parklands of Floyds Fork PNC Center/Egg Lawn 8:00 p.m.
 Sat. 14th: 8:00 pm Public Night at Curby
 Sun. 15th: Astronomy Day 1-5 pm UofL Planetarium
 Fri. 20th: 6:30 pm Board meeting at UAC
 Fri. 20th: 8:00 pm General Meeting and Annual Election of the Board of Directors
 Sat. 21st: 8:00 pm Public Night at the UAC

JUNE

- Sat. 4th: Member Only Night at Curby
 Fri. 10th: 8:00 pm Skies Over Louisville at the Planetarium
 Sat. 11th: 7:00 pm Welcome Summer Camping Night and Earth Measure at Bernheim.
 Sat. 11th: 8:00 pm Public Night at Curby
 Fri. 17th: 6:30 pm Board Meeting at UAC
 Fri. 17th: 8:00 pm General Meeting at UAC
 Sat. 18th: 8:00 pm Public Night at the UAC

JULY

- Sat. 2nd: Member Only Night at Curby
 Fri. 8th: 8:00 pm Skies Over Louisville at the Planetarium
 Sat. 9th: 8:00 pm Public Night at Curby
 Sat. 9th: 8:30 pm Planet Watch at Blackacre Nature Conservancy
 Sat. 9th: Patoka Lake Star Party with the EAS
 Sat. 16th: 8:00 pm Public Night at the UAC

AUGUST

- Fri. 12th: 8:00 pm Skies Over Louisville at the Planetarium
 Fri. 12th 9:00 pm Planet Watch at Blackacre Nature Conservancy
 Sat. 13th: 8:00 pm Public Night at Curby
 Sat. 20th: 8:00 pm Public Night at the UAC
 Sat. 27th: 6:00 pm Connect Event at Bernheim
 Sat. 27th: Member Only Night at Curby

SEPTEMBER

- Sat. 3rd: Member Only Night at Curby
 Fri. 9th: 8:00 pm Skies Over Louisville at the Planetarium
 Sat. 10th: 8:00 pm Public Night at Curby
 Fri. 16th: 6:30 pm Board Meeting at UAC
 Fri. 16th: 8:00 pm General Meeting at UAC
 Sat. 17th: 8:00 pm Public Night at the UAC\

OCTOBER

- Sat. 1st: Member Only Night at Curby
 Sat. 8th: 8:00 pm Public Night at Curby
Sat. 8th: LAS at Norton's Common (provisional) Time to be determined
 Fri. 14th: 8:00 pm Skies Over Louisville at the Planetarium
 Sat. 15th: 8:00 pm Public Night at the UAC
 Fri. 21st: 6:30 pm Board Meeting at UAC
 Fri. 21st: 8:00 pm General Meeting at UAC

NOVEMBER

- Fri. 11th: 8:00 pm Skies Over Louisville at the Planetarium
 Sat. 12th: 8:00 pm Public Night at Curby
 Sat. 19th: 8:00 pm Public Night at UAC
 Sat. 26th: Member Only Night at Curby

DECEMBER

- Sat. 3rd: Member Only Night at Curby
 Fri. 9th: 8:00 pm Skies Over Louisville at the Planetarium
 Sat. 10th: 8:00 pm Public Night at the UAC
 Sat. 17th: 6:00 pm Sky Watch and Star Stories at Bernheim
 LAS Christmas/Holiday Party. Date to be determined.

At the May 20th General Meeting LAS Member Bo Lowrey will be our Guest **Speaker. His topic is: "A Primer on Radio Astronomy". Let's show him our support** as we come out to vote. Thanks again, it has been a great 6 years as Editor and serving on the Board.

DARK MATTER – HARBINGER OF GEOLOGIC CHANGE

By

Angelo I. George

Sixty-six million years ago at the end of the Cretaceous there was a major extinction when 75% of all species perished when a comet the size of Mount Everest crashed into Central America. Another bolide formed the Shiva Crater on the seafloor west of India at the same time. Shocked quartz and elevated iridium have been recovered from these layers. These events may have been instrumental in initiating flood-basalt eruptions in west-central India. For 30,000 years molten lava covered an area of 500,000 km² to a depth of 2000 m. Life forms, especially the dinosaurs were already experiencing decline in population – perishing when the meteors struck. The atmosphere was poisoned with Sulphur dioxide (sulfuric acid), carbon monoxide and carbon dioxide (carbonic acid) to toxic levels. Atmospheric dust from impact events lingered for a long duration in what has **been called a “nuclear winter” impact scenario**. Some Earth scientists have challenged the Shiva Crater hypothesis.

Particle physicist and cosmologist, Lisa Randall (2015) has published a book, *Dark Matter and the Dinosaurs*, based in large part on scientific papers coauthored with Matthew Reece. The following book review presents some of the arguments for dark matter as the principle cause for major extinctions and geologic changes. The book is a good read challenging current theory with possibilities for revising geological processes operating on the Earth and planets in

the Solar System.

The double disk dark matter model theory proposes dark matter is responsible for at least five major extinctions since the Cambrian. Dark matter dislodges icy comets from the Oort cloud that encircles the Solar System and predictably on cue, with the right circumstances, hurls ice chunks the size of mountains into the inner Solar System. Some of them hit the Earth and cause major extinctions. Scientific critics have questioned the theory as a stretch and she is going to have a hard time proving its validity. If the theory proves correct, then it **ranks right up there with Wegner’s discovery of continental drift, identification of craters on the Earth and Moon as caused by meteor impacts and catastrophic events as agents of geologic change – extinctions and evolution.**

It is a good theory with two major exceptions. We do not know what dark matter is, or even if it exist in our own galaxy. Quantum physicists have hypothesized it is made up of weakly interacting massive particles (WIMPS), the size of the Higgs boson, ten times as heavy without an electric charge, interacts with itself and with ordinary matter. No one has ever seen dark matter, nor identified the particle in any terrestrial experiments. It does not emit energy or light and is completely invisible. Dark matter could be hiding in plain sight and we have not recognized it for what it is.

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Astronomers know it's there, because of its strong gravitational lens effect on stars and galaxies. Dark matter (27%) makes up most of the matter in the universe, and dark energy accounts for 68%. Visible matter is only 5%. Dark matter theoretically is what keeps galaxies from flying apart. It exists as an invisible ball surrounding every galaxy and fills the fabric of space between all the stellar objects.

Surrounding the Solar System is the Oort cloud of icy chunks of matter, and is found about 1000 AU from the Sun and extends into outer space to 50,000 AU. One astronomical unit (AU) is a measurement equal to 93,000,000 miles, the distance between the Sun and the Earth. A number of theories for ejecting long duration comets from the Oort cloud have been proposed. Tidal effects are created by passing stars as the Solar System rotates around the Milky Way Galaxy. The tidal forces of an orbiting Nemesis Star or Planet X, perturbations of the galactic spiral arms impacting on the Solar System could have launched comets from the Oort cloud. **Randall (2015, p. 354) submits “with only normal matter in the disk to influence the motion, the Sun’s vertical oscillation period would be more like 50 to 60 million years – too long to match the available data.”** Statically none of these causative events occur with any predictable periodicity, requiring a rethinking for a new theory about how the Galaxy is constructed and its collective impact on the Oort cloud surrounding the So-

lar System.

Our Solar System is located on one of the far spiral arms in the outer rim of the Milky Way Galaxy. It takes 240 million years for the Solar System to make one completed orbit. The thickness of the galactic plane is about 2000 light years. As the Solar System travels around the galaxy, it bobbles up and down through the galactic plane in regular intervals every 32 million years. Gravitational tidal forces are strongest when the Solar System intersects the zone of the galactic plane. Oort cloud objects are ejected toward the inner Solar System, but the amount of visible matter in the galactic plane is not enough to tidal eject objects out of the Oort cloud.

Lisa Randall and Matthew Reece (2014) overcame this obstacle by proposing the existence of a very thin disk of dark matter bisecting the galactic plane. There would be enough mass and surface density to kick Oort cloud objects into the inner Solar System whenever the Solar System crosses the galactic plane, every 32 million years. **Randall (2015, p. 355) proposes “for periodic strikes to occur, a rapid change in the rate of disruptions to the Oort cloud must occur at regular intervals. Furthermore, to match the available evidence, the period must be in the range of 30 to 35 million years.”** She (Randall, 2015, p. 358) revised this value **“with recent data improvements indicate the period is likely to be a bit shorter even – per-**

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haps 32 million years.” This value matches geologic events, major extinctions, and time pattern of Solar System bobbing through the galactic plane. The time period shows good correlation with meteor impact crater clusters greater than 20 km in diameter. Significant geologic events (flood-basalt eruptions, magnetic polar reversals, climate change, major extinctions, and perhaps accelerated seafloor spreading) occur on Earth every time the Solar System crosses the galactic plane, comets are shunted our way. Just how dark matter interacts geodynamically **with the Earth’s upper mantle and mantle material** is a subject geologists will discover for years to come. A whole new field of geologic inquiry waits. Randall (2015, p. 357) hypothesized the thickness of the dark matter disk could be only a few hundred light-years, and **“it is this narrowness of the dark disk that explains why it can conceivably trigger dramatic effects on a periodic basis.”** The Solar System takes about a million years to cross the galactic plane, perhaps two million years if the dark matter disk is thicker (Randall, 2015, p. 360-361). This is a long geological time period.

Randall (2015, p. 360-361) hypothesizes there could be a lag time period (several million years) **between crossings and “initial triggering event from the actual meteoroid hit on Earth.”** The end of the Pleistocene megafauna extinctions fits this scenario. Unsettling, is that today we could still be in the shadow of this last extinction. Some bi-

ologists think the Earth is experiencing a sixth extinction right now! If not man induced, or a normal species evolution and extinction, then dark matter may still be playing a part today continuing the late Pleistocene extinction with extinctions occurring today. Exactly how dark matter aids **extinctions on today’s species is a mystery, if indeed dark matter is the cause.**

Randall (2015, p. 359) writes **“we passed through the galactic plane within the last two million years,”** and that caused me to start thinking geologically. This crossing would be during the late Pliocene and Pleistocene, our Ice Age. Worldwide megafauna were already stressed and became extinct 12,900 years ago along with the Clovis People. Archaeologists have found a soot layer just above Clovis sites all across North America. A Clovis site in a northern Ohio cave has meteoritic iron particles associated with the soot interval (Kenneth Tankersley, personal communication). The meteorite crater responsible for continental wide wildfires and extinctions has not been identified. The crater could be a geologic feature mapped as something else, or covered over with deep glacial deposits and no longer visible.

Randall (2015, p. 266) plays the Devil’s advocate and considers: (1) data and interpretation is not real, or (2) the internal construction of the galaxy is different than we **know about, “hence the tidal effect could be**

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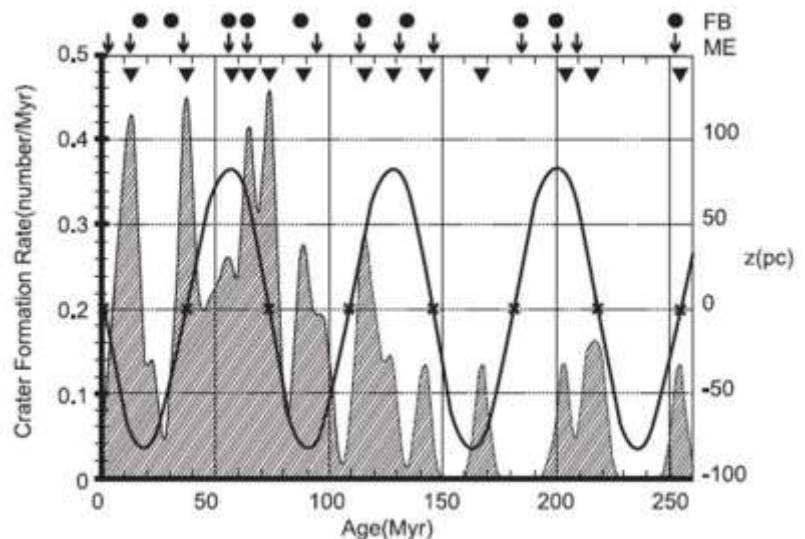
stronger than realized.” She was concerned and thought the whole idea was outlandish. **But the idea “paid off” as the theory grew in** concept, and sparse data strengthened the supposition for a thin disk of dark matter bisecting the Milky Way. Dark matter provides just the right mass needed to eject comets into the inner Solar System. This thin disk of dark matter has not been detected, but NASA has launched a satellite (GAIA) to 3-D map stars in the galactic plane in our region. With greater clarity, dark matter interaction with these stars might reveal its presence.

In the geologic record are engaging events that strengthens the 32 million year Oort cloud comet theory of bombardment of the Earth. Paleoclimatological work on the entire 540 million year Phanerozoic era was conducted by Nir Shaviv, Hebrew University of Jerusalem (Randall, 2015, p. 361), and found a remarkable correlation between variations in climates “with a period of **32 million years....** If Shaviv’s results hold up and this periodicity in climate is indeed determined by the **Sun’s motion through the galactic plane**, the 32-million-year period too would be evidence of a dark disk since ordinary matter alone **wouldn’t suffice to yield this relative short interval between disk crossings.” We do not yet know if a disk of dark matter bisects the galactic plane, and that’s the biggest prob-**

lem with the theory. A number of cosmologists are working on the dark matter problem, its detection and interaction with the Solar System.

The five great extinctions between the Cambrian and the end of the Cretaceous have a statically smoothed periodicity of 32 million years. Not every 32 million years did extinctions occur, but other geological events did. **Rampino (2015) adds clarity to Randall’s** theory, every time the Solar System crosses through the galactic plane:

It can be seen that, over the last 260 Myr, 9 of the 13 proposed impact pulses correlate closely with times of mass extinction (including the Late Paleocene warming event), 7 impact pulses correlate with flood-basalt eruptions, 7 flood basalts correlate with mass extinctions and 6 impact pulses can be correlated with estimated times of the Solar system crossing the Galactic plane in the last 260 Myr.



DARK MATTER - HARBINGER OF GEOLOGIC CHANGE

Key figure used by Michael Rampino (MNRAS, 2015) showing periodicity of the Solar System travel through the galactic plane (sign wave marked with an X intersection of the galactic plane), solid dots (FB, flood-basalts events), arrows (ME, mass extinction events), solid inverted triangles (peak cratering record), hatched wave form (probability distribution curve for crater formation rates, number per million years over the last 260 million years).

These data alone gives me serious thought **in consideration for Randall's theory. Extending the boundaries of Rampino's (2015) chart into greater geological deep time, shows a good fit with other extinctions, especially the Late Devonian (360 million years ago), and the end Ordovician (440 million years ago) extinctions. They have strong correlation with the Solar System crossing the galactic plane. Extinctions older than the Ordovician do not show a match. Rampino's chart matches become something of an eye opener to greater inquiry.**

Albert Fisher and Michael Arthur in 1977 studied the fossil record and determined life in general seemed to wax and wane on a regular basis. The fossil record also indicates a 32 million year periodicity, ending in extinction (Randall, 2015, p. 242). Other paleontologists found a periodicity of 26 million years, to as high as 62 million years span between extinctions.

Geologic dates for meteorite impacts were

also examined. Michael Rampino and Richard Stothers (1984) sampled 41 large craters formed over a 250 million years range. They found a 31 million year period of impacts spaced regularly over geologic time.

William Napier (2006) sampled 40 craters larger than 4 km that are over the past 250 million years. Cratering appears to occur in groups in a short time frame separated by about 25-30 million years. He considered the source of the meteorites and estimated there were not enough asteroids large enough to make all the big Earth craters and deduces that comets cause craters on the Earth on a regular basis every 25-30 million years. Earlier, Eugene Shoemaker (1998) favored a similar conclusion for comets making all the big craters. Napier issued a word of caution that the data set was not large and the results less than approximate, **but the data still gives cause to attract one's attention to look more closely.**

Randall (2015) reexamined meteorite craters 20 km diameter or larger and the data sample amounted to 43 known craters. Of that sampling, 34 were formed within the last 500 million years and of that number, 26 within the last 250 million years. There are only about 200 known craters on the Earth, and only a small number do we have good geologic dates for their time of formation. Fossil craters greater than 20 km have all been eroded prior to burial with younger material. Geologic dates are approximate.

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Even with this level of uncertainty, it gives a formation periodicity of 25 to 31 million years. Impressive! Given the scarcity of good geologic cratering dates in the geologic record.

Not covered in the book is the breakup of the Pangaea supercontinent beginning in the Early Middle Jurassic, 180 million years ago. **Using Rampino's (2015) chart of our Solar System crossing the galactic plane, the initial breakup occurred during one of these galactic plane crossings.**

Randall's speculative theory is called the double disk dark matter model and is constructed with a thin disk of dark matter sandwiched between galactic disks of visible matter. Her book excited my interest to Google the Internet for more dark matter investigations into extinctions and geologic changes. As a geologist and amateur astronomer, I was particularly taken with her book and broad scale implications in historical geology. The book left me with more geological questions, especially late Pleistocene and Recent extinction events, and the breakup of Pangaea were at the top of the list. The dark matter theory lays the groundwork for a general theory of mass extinctions and geologic change. The book caused me to be prepared to change my own way of thinking if dark matter is shown to spawn comets out of the Oort cloud into the inner Solar System affecting geological activity, extinctions and evolutionary events on the Earth.

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LOUISVILLE ASTRONOMICAL SOCIETY

MEMBERSHIP DUES

Please help us out as we cannot continue WITHOUT YOU.

Louisville Astronomical Society
P.O. Box 17554
Louisville, KY 40217-0554
<http://www.louisville-astro.org>

Please fill out the information below and mail it in to the address to the left.
Please make checks or money orders payable to
Louisville Astronomical Society.

Dues/Membership Level (Please Circle One): Family (\$35) Single (\$30) Student (\$20) Senior (Age 62 and above) (\$20)

Member information: Name: _____

Address: _____

City: _____ State: _____ Zip Code: _____

Phone Number: _____-_____-_____ Date: ____/____/____

E-mail Address: _____@_____

If you do not have an e-mail address or internet access, please indicate if you wish to have a copy of the STARWORD News-
letter mailed to your address. [] Yes [] No

Benefits of joining the LAS: STARWORD either on-line or printed; Access to the James G Baker Center for Astronomy (after training). Use of the Multipurpose Building at Curby or at the UAC, (after training); Ability to vote for the Officers and the Board of Directors; Astronomical presentations at the monthly General Meeting; Participation in many public and education outreach programs; and, Training in the use of LAS equipment or in your own equipment. In order to receive the code to the Observatory at Curby, the Multiuse Building at Curby or the UAC, you must attend training on the equipment, the requirements and rules regarding use of LAS Equipment and Property.



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